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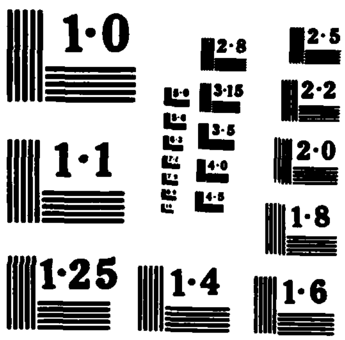

NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

AD-A158 027

AFGL-TR-85-0007

"IE" DATA PROCESSING

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Scientific Report No. 1

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AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Two satellites are generating and have been generating "SSIE" data for several years. Because of the large volume of information (approx. 180 bits/second per satellite) and noise contained in it, a computer software system has been developed at AFGL to handle the data and make it available for in-house use. The intent is to allow AFGL personnel various desired window looks at the data through graphics, listings or data downloading. The building of the "SSIE" database is an on-going process and new application packages are added as needed.

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1. BACKGROUND

The SSIE is a thermal plasma experiment flown on spacecrafts F2 through F7 of the Defense Meteorological Satellite Program (DMSP). The DMSP satellites fly in a 835 Km, 98.7 degree orbit. The SSIE consists of a spherical electron sensor and a planar ion sensor which record thermal ion and electron values (see reference for details of the sensor operations). Every second, 180 bits (twenty 9-bit bytes) of information are recorded on tape and later transmitted to a ground station[1] [2]. There they are collected and sent to Air Force Global Weather Central at Offutt Air Force Base, Nebraska. The data are used operationally and then archived on tape with data from other AFGL-provided sensors. One tape holds approximately one day of raw data. After the tape has been created, it is sent to AFGL for permanent archiving and research.

The set of programs described here handles the process of archiving the F6 and F7 SSIE data. The programs were written to work on a CDC main-frame under the NOSBE operating system and have been converted to work under the NOS operating system.

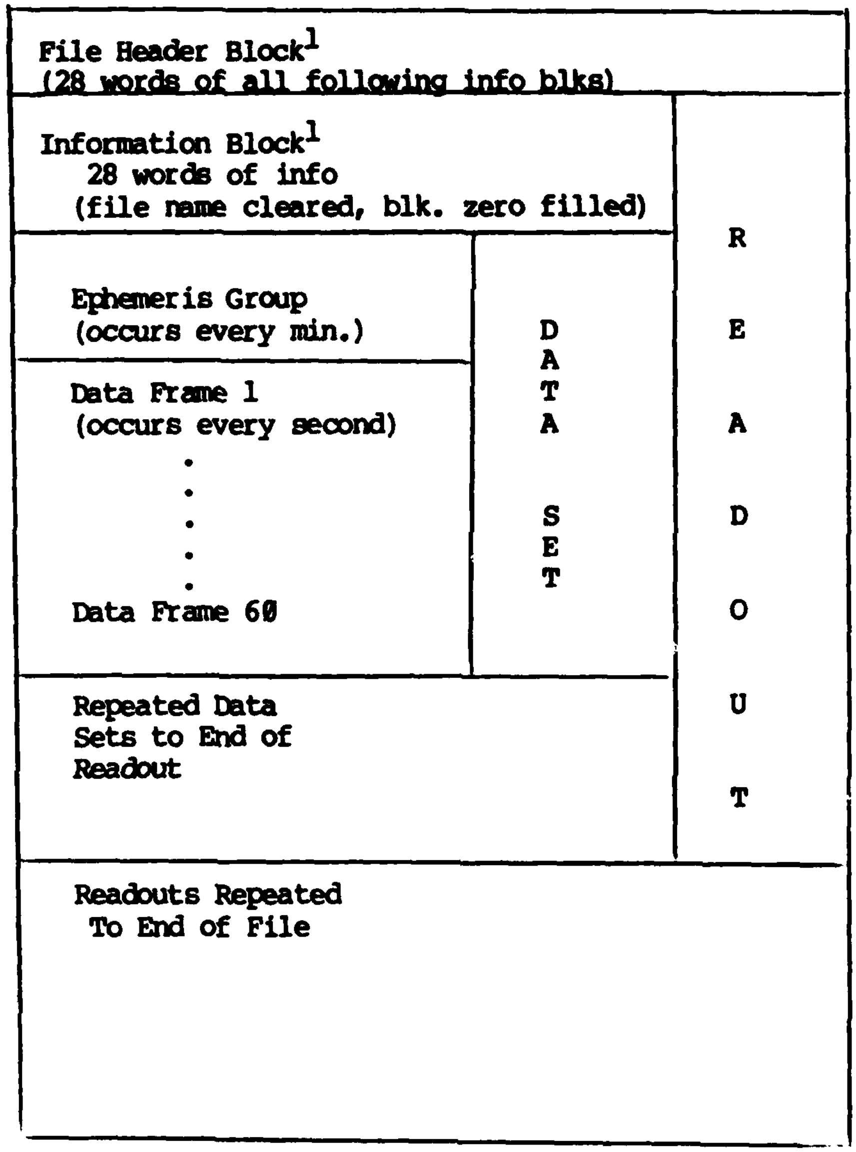
2. SSIE RAW DATA

The following is a description of the SSIE data as it exists in the IEPREPFILE on the tapes received from AFGWC. Figure 1 shows the structure of an SSIE tape file. Each tape contains several files with each file containing approximately 24 hours of data for a particular instrument on board one of the DMSP satellites (i.e., data for the IE instrument). Presently there are two DMSP satellites operating, F6 and F7, with several instruments on board each, i.e., J/4, J*, IE, M, etc.

Figures 2 and 3 are an explanation of the data items (and their lengths) in the information block. The readouts indicated by the information blocks differ in time lengths from several minutes to five or six hours, but are usually of length about ninety minutes.

A readout is a section of data sent from the satellite to a ground station as it passes overhead. The satellite can send information only when it is in a direct line of communication with the ground station. Since the satellite passes over the ground station at varying degrees of view, variable amounts of information are sent in the readouts.

LAYOUT OF INPUT GWC SSIE DATA TAPE FILE



1 All Blocks Are Fixed Length 112Ø UNIVAC 36 Bit Words

Figure 1

READOUT-INFORMATION-RECORD DEFINITIONS

ITEM#	NAME OR LABEL	DEFINITION
1.	BATCH NUMBER	PROCESSING BATCH NUMBER ASSIGNED TO READOUT BY PROGRAM THAT GENERATES IT.
2.	MISSION ID	SATELLITE MISSION IDENTIFIER, ENCODED AS 6 FIELD-DATA CHARACTERS, E.G. WX754D. (NOTE: ITEM MUST BE ENCODED AS 4 ASCII CHARACTERS FOR MIPREPFILE READOUTS, E.G., 754D.
3.	READOUT REV	NUMBER OF THE SATELLITE REVOLUTION DURING WHICH THE READOUT WAS TRANSMITTED. USUALLY DOES NOT CORRESPOND EXACTLY TO THE REVS DURING WHICH THE DATA WERE RECORDED.
4.	NODAL LONG.	LONGITUDE OF THE ASCENDING NODAL CROSSING OF THE READOUT REV IN TENTHS OF DEGREES EAST.
5.	NODAL JULHR	AFGWC SYSTEM TIME OF READOOUT REV NODAL CROSSING IN CUMULATIVE HOURS SINCE 0000Z 31 DEC 1967.
6.	NODAL DAY	JULIAN DAY OF READOUT REV NODAL CROSSING.
7.	NODAL MONTH	MONTH OF READOUT REV NODAL CROSSING.
8.	NODAL YEAR	YEAR OF READOUT REV NODAL CROSSING.
9.	NODAL TIME	TIME OF READOUT REV NODAL CROSSING.
		NOTE FOR ITEMS 10-22 THE TERMS "FIRST" AND "LAST" DENOTE THE POSITION OF THE RECORD IN THE CF-READOUT AND DO NOT DENOTE THE CHRONOLOGICALLY EARLIEST OR LATEST DATA. IN SOME CF-READOUTS (E.G. PREP-READOUTS) THE FIRST RECORD CONTAINS THE LATEST DATA AND THE LAST RECORD CONTAINS THE EARLIEST. IN OTHER CF-READOUTS (E.G., J4-SDR-READOUTS) THE REVERSE IS THE CASE.
10.	BEGINNING ADDR	BEGINNING FILE SECTOR OF CR-READOUT.
11.	ENDING ADDR+1	ENDING FILE SECTOR +1 OF CF-READOUT.

Figure 2

(continued on next page)

ITEM #	NAME OR LABEL	DEFINITION
12.	RECORD COUNT	NUMBER OF DATA RECORDS IN CF-READOUT = NO. OF MIN.
13.	FIRST JULDAY	JULIAN DAY OF FIRST RECORD IN CF-READOUT.
14.	FILLER	
15.	FIRST HOUR	NOUR OF FIRST RECORD IN CF-READOUT.
16.	FIRST MINUTE	MINUTE OF FIRST RECORD IN CF-READOUT.
17.	FIRST SECOND	SECOND OF FIRST RECORD IN CF-READOUT.
18.	LAST JULDAY	JULIAN DAY OF LAST DATA IN CF-READOUT.
19.	FILLER	
20.	LAST HOUR	HOUR OF LAST DAY IN CF-READOUT.
21.	LAST MINUTE	MINUTE OF LAST DATA IN CF-READOUT.
22.	LAST SECOND	SECOND OF LAST DATA IN CF-READOUT.
23.	TAPE BLOCKS	NUMBER OF TAPE BLOCKS WRITTEN FOR CF-READOUT IN ARCHIVE-TAPE-FILE. ENTERED BY SSTWRT ON ARCHIVE-TAPE ONLY.
24.	READOUTS TAPED	NUMBER OF CF-READOUTS IN ARCHIVE-TAPE-FILE. ENTERED BY SSTWRT IN FIRST READOUT — INFORMATION-RECORD IN ARCHIVE-TAPE-FILE.
25.	CF-NAME	NAME OF CIRCULAR-FILE FROM WHICH ARCHIVE — TAPE-FILE WAS MADE. ENTERED BY SSTWRT IN ARCHIVE-TAPE-FILE ONLY. ENCODED LEFT JUSTIFIED IN 12 FIELDATA CHARRACTERS. WORD 14 IS EMPTY. FILE NAME WAS 15-16. IS ONLY IN INFO BLOCK OF FIRST READOUT ON FILE.
26.	R+NUMBER	READOUT REV NUMBER RELATIVE TO BEGINNING OF SATELLITE DAY. THE SATELLITE DAY BEGINS AT THE FIRST ASCENDING NODAL CROSSING AT OR WEST OF 68.1W. (I.E., LESS THAN OR EQUAL TO 291.9E).
27.	TIME BREAKS	NUMBER OF TIME-CODE DISCONTINUITIES IN THE RAW-SSP-READOUT.
28.	FRAME COUNT	NUMBER OF ONE-SECOND DATA FRAMES STORED IN THE PRE-PROCESSED-READOUT.
29-38	DATA-REQUEST-NUMBERS	NUMBERS OF THE DATA-REQUESTS THAT THE READOUT HAS BEEN SEARCHED FOR. (E.G., B01)

Figure 2 (Cont'd)

READOUT-INFORMATION-RECORD CONTENTS

ITEM NBR	POSITION WORD	POSITION BITS	POSITION FLD	ITEM NAME OR LABEL	TYPE	RANGE OR NOMINAL VALUE	UNITS
1	1	1-36		BATCH NUMBER	1	1-99	BATCH
2	2	1-36		MISSION ID	A	SEE DEF	NONE
3	3	1-36		READOUT REV	I	1-INDEF	REV
4	4	1-36		NODAL LONG.	I	0-3600E	DEGS/10
5	5	1-36		NODAL JULHR	I	1-INDEF	HOURS
6	6	1-6	S1	NODAL DAY	I	1-31	DAYS
7	6	7-12	S2	NODAL MONTH	I	1-12	MONTHS
8	6	13-24	T2	NODAL YEAR	I	00-99	YEARS
9	6	25-36	T3	NODAL TIME	I	0000-2359	HRS/MINS
10	7	1-36		BEGINNING ADDR	I	4+	SECTORS
11	7	1-36		ENDING ADD+1	I	4+	SECTORS
12	9	1-36		RECORD COUNT	I	INDEF	COUNT
13	10	1-12	T1	FIRST JULDAY	I	1-366	DAYS
14	10	13-18		FILLER		0	NONE
15	10	19-24	S4	FIRST HOUR	I	00-23	HOURS
16	10	25-30	S5	FIRST MINUTE	I	00-59	MINUTES
17	10	31-36	S6	FIRST SECOND	I	00-59	SECONDS
18	11	1-12	T1	LAST JULDAY	I	1-366	DAYS
19	11	13-18		FILLER		0	NONE
20	11	19-24	S4	LAST HOUR	I	00-23	HOURS

Figure 3

READOUT-INFORMATION-RECORD CONTENTS

ITEM NBR	POSITION WORD	POSITION BITS	POSITION FLD	ITEM NAME OR LABEL	TYPE	RANGE OR NOMINAL VALUE	UNITS
21	11	25-30	S5	LAST MINUTE	I	00-59	MINUTES
22	11	31-36	S6	LAST SECOND	I	00-59	SECONDS
23	12	1-36		TAPE BLOCKS	I	INDEF	BLOCKS
24	13	1-36		READOUTS TAPED	A	1-45	NONE
25	15-16	1-36		R+ NUMBER	I	INDEF	NONE
26	17	1-36		R+ NUMBER	I	00-14	NONE
27	19	0-36		TIME-BREAKS	I	INDEF	BREAKS
28	18	0-36		FRAME COUNT	I	INDEF	FRAMES
29-38	20-29	1-18		RESERVED FOR SSRT-DATA-REQUEST-NBR	A	INDEF	NUMBER

Figure 3 (Cont'd)

Figures 4 and 5 are an explanation of the data items (and their lengths) in the ephemeris part of a data set (refer to Figure 1). This ephemeris is tagged to the data in Nebraska and contains satellite location parameters at time 1 and time 60 of each data set. There will always be sixty seconds of data. Should some records be missing because of transmission problems, they are filled in with zeroes. Thus, there is a fixed amount of bits per data set.

Figure 6 is an explanation of the data items (and their lengths) in a data frame (refer to Figure 1) which occurs every second. Figure 7 contains further comments on the raw data, pointing out some changes from previous flights.

EPHEMERIS-RECORD ITEM DEFINITIONS

ITEM #	NAME OR LABEL	DEFINITION
1,6	LATITUDE-N	GEODETIC LATITUDE OF SATELLITE SUBPOINT IN RADIANS EAST.
2,7	LONGITUDE-N	LONGITUDE OF SATELLITE SUBPOINT IN RADIANS. + = NORTH, - = SOUTH.
3,8	ALTITUDE-N	ALTITUDE OF SPACECRAFT ABOVE MEAN SEA LVL.
4,9	JULIAN-DAY-N	JULIAN DAY
5,10	TIME-N	TIME OF SATELLITE LOCATION IN ELAPSED SECONDS SINCE 00Z OF JULIAN-DAY-N.
11,14	X-N	X UNIT ORIENTATION VECTOR
12,15	Y-N	Y UNIT ORIENTATION VECTOR
13,16	Z-N	Z UNIT ORIENTATION VECTOR
		NOTE THE UNIT VECTORS ABOVE ARE NOT BASED ON THE TRUE GEOCENTER. RATHER THEY ARE DERIVED TRIGONOMETRICALLY FROM THE GEODETIC LAT/LONG AND THUS DEFINE THE SAME POINT ON THE EARTH'S SURFACE AS LATITUDE-N/LONGITUDE-N.
17,20	LATITUDE-NA	GEODETIC LATITUDE IN RADIANS X 10000. + = NORTH, - = SOUTH.
18,21	LONGITUDE-NA	LONGITUDE IN RADIANS X 10000 EAST.
19,22	ALTITUDE-NA	ALTITUDE ABOVE MEAN SEA LEAVEL (FLOATING PT).
23,24	SATH-N	SATH ANGLE: ANGLE ON THE ORBITAL PLANE BETWEEN THE ASCENDING NODE (EQUATOR) AND SATELLITE LOCATION.
25,28	DATA-REV	

Figure 4

EPHEMERIS-RECORD-CONTENTS

ITEM NBR	WORD	BITS	FLD	ITEM NAME OR LABEL	TYPE	RANGE OR NOMINAL VALUE	UNITS
1	1	1-36		LATITUDE-1	R	∅ +/1 PI/2	RADIANS
2	2	1-36		LONGITUDE-1	R	∅ - 2PI	RADIANS
3	3	1-36		ALTITUDE-1	I	441-459	NM
4	4	1-36		JULIAN-DAY 1	I	1-366	DAYS
5	5	1-36		TIME-1	I	∅-86399	SECONDS
6	6	1-36		LATITUDE-2	R	∅ +/- PI/2	RADIANS
7	7	1-36		LONGITUDE-2	R	∅ -2PI	RADIANS
8	8	1-36		ALTITUDE-2	I	441-459	NM
9	9	1-36		JULIAN-DAY 2	I	1-366	DAYS
1∅	1∅	1-36		TIME-2	I	∅-86399	SECONDS
11	11	1-36		X-1	R	UNK	UNK
12	12	1-36		Y-1	R	UNK	UNK
13	13	1-36		Z-1	R	UNK	UNK
14	14	1-36		X-2	R	UNK	UNK
15	15	1-36		Y-2	R	UNK	UNK
16	16	1-36		Z-2	R	UNK	UNK
17	17	1-36		LATITUDE-1A	I	∅ =/- PI/2	RAD*1∅∅∅∅
18	18	1-36		LONGITUDE-1A	I	∅ - 2PI	RAD*1∅∅∅∅
19	19	1-36		ALTITUDE-1A	R	441.∅-459.∅	NM
2∅	2∅	1-36		LATITUDE-2A	I	∅ +/- PI/2	PAD*1∅∅∅∅∅

Figure 5

(continued on next page)

EPHEMERIS-RECORD-CONTENTS (Cont'd)

ITEM NBR	WORD	BITS	FLD	ITEM NAME OR LABEL	TYPE	RANGE OR NOMINAL VALUE	UNITS
21	21	1-36		LONGITUDE-2A	I	Ø - 2PI	RAD*10000
22	22	1-36		ALTITUDE-2A	P	441.Ø-459.Ø	NM
23	23	1-36		SATH-1	R	Ø.Ø-36Ø.Ø	DEGREES
24	24	1-36		SATH-2	P	Ø.Ø-36Ø.Ø	DEGREES
25	25	1-36		DATA-REV-1	I	UNK	UNK
26	26	1-36		ØØ-	I	1-4	UNK
27	27	1-36		DATA-REV-2	I	UNK	UNK
28	28	1-36		ØØ-	I	1-4	UNK

NOTE: ITEMS SUFFIXED WITH -1 REFER TO THE SATELLITE LOCATION AT THE TIME OF THE FIRST (LATEST) PPEP-FRAME IN THE PREP-RECORD. ITEMS SUFFIXED WITH -2 REFER TO THE SATELLITE LOCATION AT A TIME 6Ø SECONDS EARLIER THAN THE TIME OF FIRST PREP-FRAME.

Figure 5 (Cont'd)

GWC SSIE RAW DATA

Word = 36 bits

Word 1	Word 2	Word 3	Word 4	Word 5	Word 6	Word 7
Synch bit pattern	Time in sec	← 20 9-bit quantities (channel counts) →				

Channel	Name of Value	Channel	Name of Value
1	electron	11	ion
2	ion	12	monitor 4
3	monitor 1	13	electron
4	electron	14	ion
5	ion	15	monitor 5
6	monitor 2	16	electron
7	electron	17	ion
8	ion	18	monitor 6
9	monitor 3	19	electron
10	electron	20	ion

1 TIME OF EACH CHANNEL

= SECONDS IN WORD1 + (CHANNEL NUMBER -1) *.05 SECONDS

Figure 6

SSIE RAW DATA

F6 Changes from F4

Satellite ID=343567656460B

Sensor Bias Mode Voltages

Mode	VB1	VB2
1	1.27	0.
2	7.54	6.31
3	16.42	15.26
4	28.93	27.87

Number of sectors per data buffer
= 64. (64 X 28 words per 4 minutes) was 56

Number of words per frame (second)
= 7. (syn time, + 5 data words) was 6

Number of ephemeris words per minute
= 28. was 32

Sync word = 256137274276B
= word 1 of frame; Bits 2-36

Time word = word 2 of frame; Bits 10-36
Time = time word/1024

Event monitor level during Cal 2 is a function of, and is used to determine, the sensor bias mode

Mode	Monitor Volts
1	0.
2	0.97
3	2.32
4	4.14

Electron sweep flag volts
= 0.59 to 0.61

Ion sweep flag volts
= 0.79 - 0.81

will be updatd after launch

Correction to data frame time was 0.820
= - 0.982 seconds

Value of "flight constant" electron
= 5. (same as F4)

Figure 7

Figure 8 is an explanation of the monitor values in the SSIE data. The PHASE II job (Figure 17) uses these values to break up the raw data bit stream into files of respective physical quantities. PHASE II job attempts to get back in sequence as soon as possible should noise exist on the input stream, thus preventing the loss of good data.

SSIE RAW DATA

DMSP Flight 4 Event Monitor Interpretation

Event Monitor Voltage Change (volts x 100) From	To	Sensor Operation Mode Change			Duration (seconds)	Frequency (seconds)
0	20	Elec: Density ion: Density	Cal 1 Cal 1	K	2	1024
20	3 of 4 values	elec: Cal 1 ion: Cal 1	Cal 2 Cal 2	M	2	0124
40	0	elec: Cal 2 ion: Cal 2	Density Density		4	1024
0	60	elec: Density ion: Density	Density (Sweep Flag) Density		2	64
60	500*	elec: Density ion: Density	Sweep Density		10	64
100*	0	elec: Sweep ion: Density	Density Density		4	64
0	80	elec: Density ion: Density	Density Density (Sweep Flag)		2	64
80	100**	elec: Density ion: Density	Density Sweep		12	64
500**	0	elec: Density ion: Sweep	Density Density		***	64

* Event monitor voltage decreases linearly from 500 to 100 during electron sweep.

** Event monitor voltage increases linearly from 100 to 500 during ion sweep.

*** Duration of density mode is 34 seconds for the first 7 of the 64-second density/sweep groups per 1064-second calibrate cycle. Duration is 26 seconds for the 8th group (the remaining 8 seconds contain the two 2-second cals and the 4 seconds of density.

Figure 8

3. DATA PROCESSING FOR "IE" DATA

The "IE" software processing system at AFGL consists of two sub-systems:

1) An interactive system for "IE" data base creation (IEDBC). This is the software which archives the "IE" data.

2) An interactive system for "IE" data base retrieval (IEDBR). This is the software which retrieves the archived data, thus enabling AFGL personnel to do basic research on this thermal plasma experiment.

Refer to Figure 9 for a user view of this software system.

"IE" PROCESSING SYSTEM

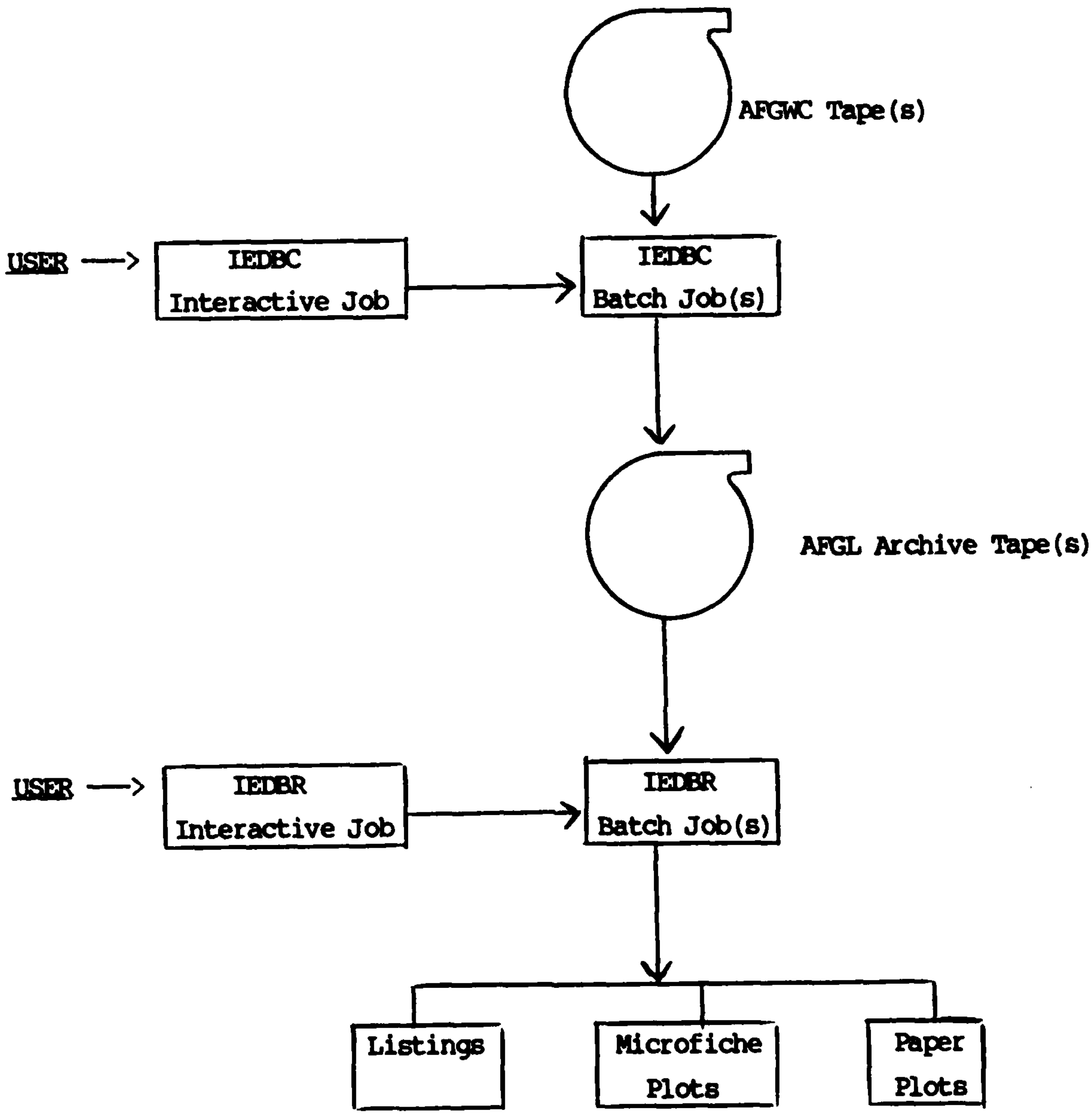


Figure 9

The file "MULLENS" under directory name "SALVETT" shows the contents of the "IE" database. A line is added to this on-line file once a file of output from Phase I or Phase II is added to the database. The following is a sample line of this file.

CC1840 E1DEC82F6

The format of the four files, ION sweep, ION non-sweep, ELECTRON sweep and ELECTRON non-sweep, is shown in Figure 10. A further breakdown of the ephemeris information is shown in Figure 11 and the channel logical record structure is displayed in Figure 12.

A breakdown of the calibration file is shown in Figures 13 and 14.

STRUCTURE OF "IE" SWEEP AND NON-SWEEP DATABASE FILES

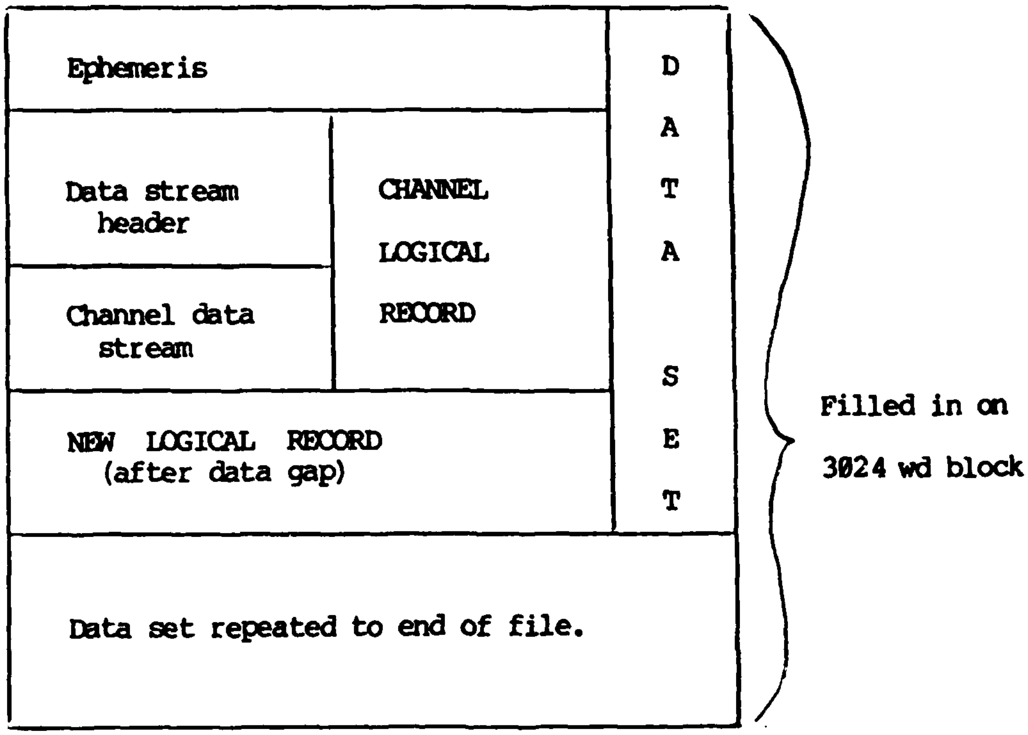


Figure 10

EPHEMERIS

BITS	VARIABLE	PACKING FORMAT
1 - 20	SLAT	Bits = (x + 500)*1000 + 1/2, Latitude
21 - 40	SLON	Bits = (x + 500)*1000 + 1/2, Longitude
41 - 60	ZLAT	Bits = " , Mag. latitude
61 - 80	ZLON	Bits = " , Mag. longitude
81 - 100	MLT	Bits = " , Mag. local time
101 - 120	ALTS	Bits = " , Altitude
121 - 140	JDAY	Bits = x , Julian day
141 - 160	ISEC	Bits = x , Sec. into day
161 - 180	EX	Bits = (x + 500)*1000 + 1/2, Earth Center Coord
181 - 200	EY	Bits = " , " " "
201 - 220	EZ	Bits = " , " " "
221 - 240	ALTT	Bits = "
241 - 260	DATE	Bits = (Year*12 + Month)*32 + Day
261 - 280	UT	Bits = x*3600
281 - 300	NTOT	Bits = x, Number of streams of channel data under this ephemeris

FOR SWEEP DATA NTOT = 0

Figure 11

CHANNEL LOGICAL RECORD

BITS	VARIABLE	PACKING FORMAT
1 - 60	TIME0	Bits = seconds*20
61 - 120	NUMBER OF CHANNEL COUNTS	Bits = x
121 - 129	CHANNEL COUNT 1	Time = TIME0
130 - 138	CHANNEL COUNT 2	Time = TIME0 + .15
139 - 147	CHANNEL COUNT 3	Time = TIME0 + .30
148 - 156	CHANNEL COUNT 4	Time = TIME0 + .45
157 - 165	CHANNEL COUNT 5	Time = TIME0 + .60
166 - 174	CHANNEL COUNT 6	Time = TIME0 + .75
175 - 183	CHANNEL COUNT 7	Time = TIME0 + .90
184 - 192	CHANNEL COUNT 8	Time = TIME0 + 1.0
.		
.		
.		

NOTE: ALL THE COUNTS ARE IN SEQUENTIAL ORDER.

FOR SWEEP DATA, "NUMBER OF CHANNEL COUNTS" IS OUT AND CHANNEL 1 IS IN THAT POSITION.

Figure 12

STRUCTURE OF "IE" CALIBRATION DATABASE FILE

CALIBRATION RECORD 7 WORDS	Filled in on 3024 word blocks

Figure 13

CALIBRATION RECORD

WORD	VARIABLE	
1	DAY	Bits = Year*366 + Day
2	MODE	Bits = E FLAG*200 + I FLAG*100 + MODE
3	TIME	Bits = seconds
4	AE	
5	BE	
6	AI	
7	BI	

full CDC words

E FLAG = 1 MEANS ELECTRON CALIBRATION IS BAD

I FLAG = 1 MEANS ION CALIBRATION IS BAD.

Figure 14

3.1 DATA BASE CREATION

The IEDBC is an interactive system which enables a user at an intercom terminal (connected to the CYBER 170 at AFGL) to create batch jobs for data base creation.

The database creation as shown in Figure 15 consists of three parts: CONCAT, PHASE 1 and PHASE II.

The "CONCAT" program copies the IEPREPFILE files from each of six input raw data tapes (as received from AFGWC, Offutt AFB, Nebraska) to one AFGL tape. Since a half-calendar month of data is processed at a time, only three of four tapes output from "CONCAT" need be hung instead of 15 or more data tapes.

The "IE" database consists of two sub databases. The PHASE I job basically inputs the raw data and packs it bit for bit, doing some data rejection and editing when necessary. Data frames with redundant times and incorrect synch words are rejected. Also, if data frames have time values distant from those of their neighbors, they are rejected. The satellite clock may not have been reset when it passed through midnight. This would account for data frames having times greater than 86400 (24*60*60) seconds. In this case, the data is tagged with the next higher day and 86400 is subtracted from its seconds count.

The PHASE II job separates the data into files of its respective raw physical quantities and brings along the calibration values used to generate the real physical values. Refer to Figures 16 and 17 for a further breakdown of PHASE I and PHASE II.

In addition to the above specified programs and jobs, there are some additional utilities used to copy database files and create back-ups of database tapes.

OVERVIEW OF CREATION OF "SSIE" DATA BASE

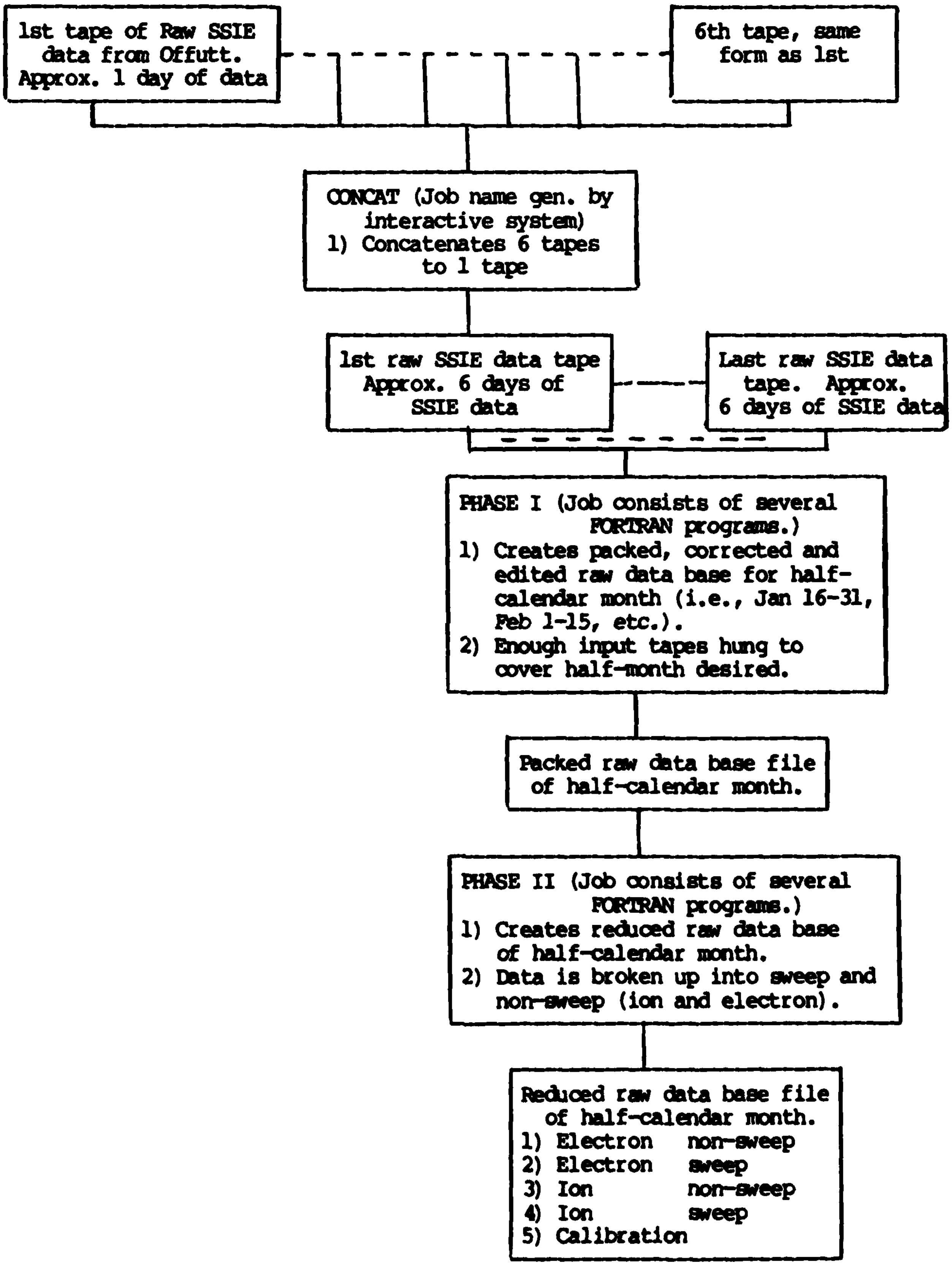


Figure 15

PHASE I

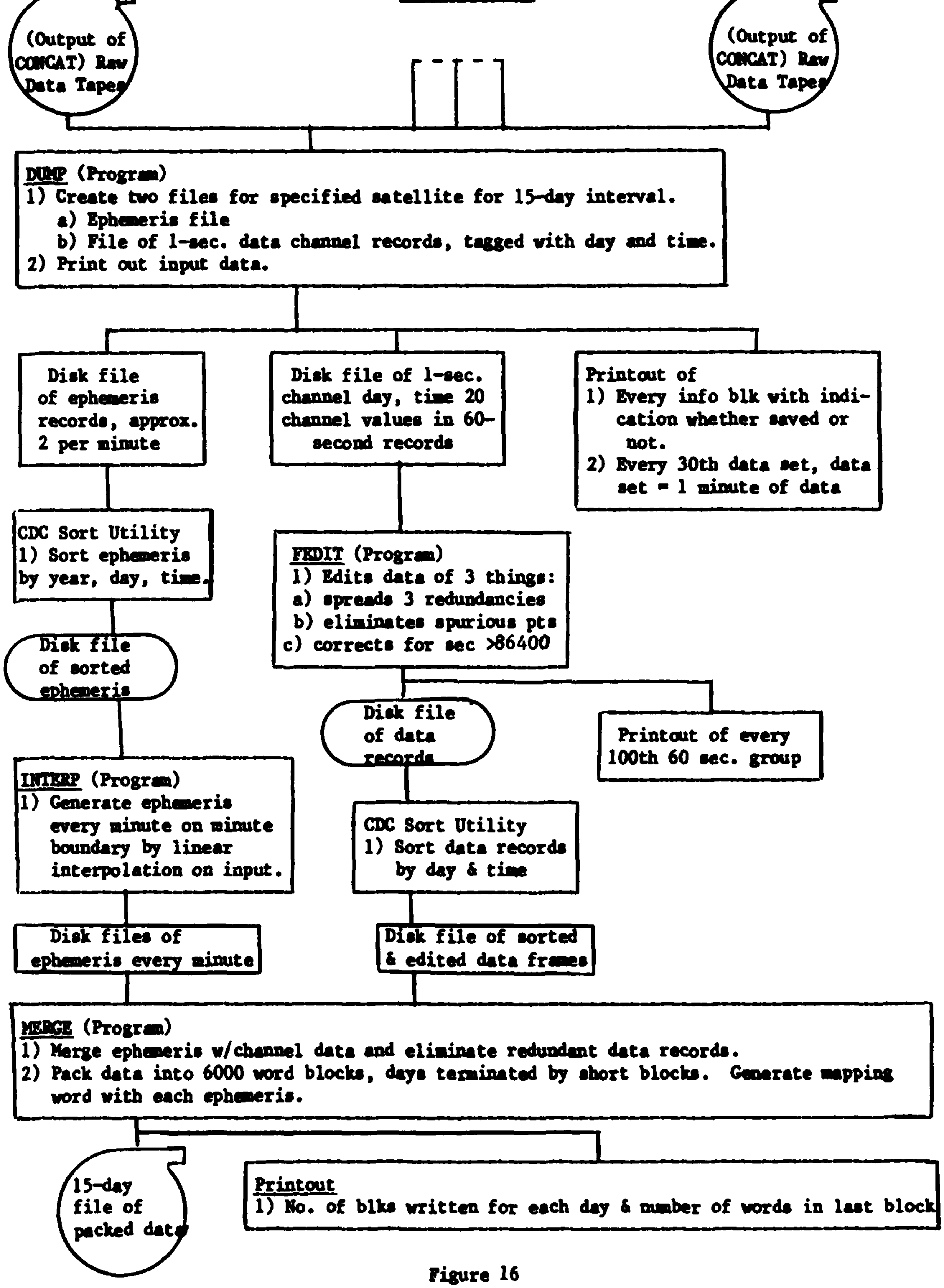
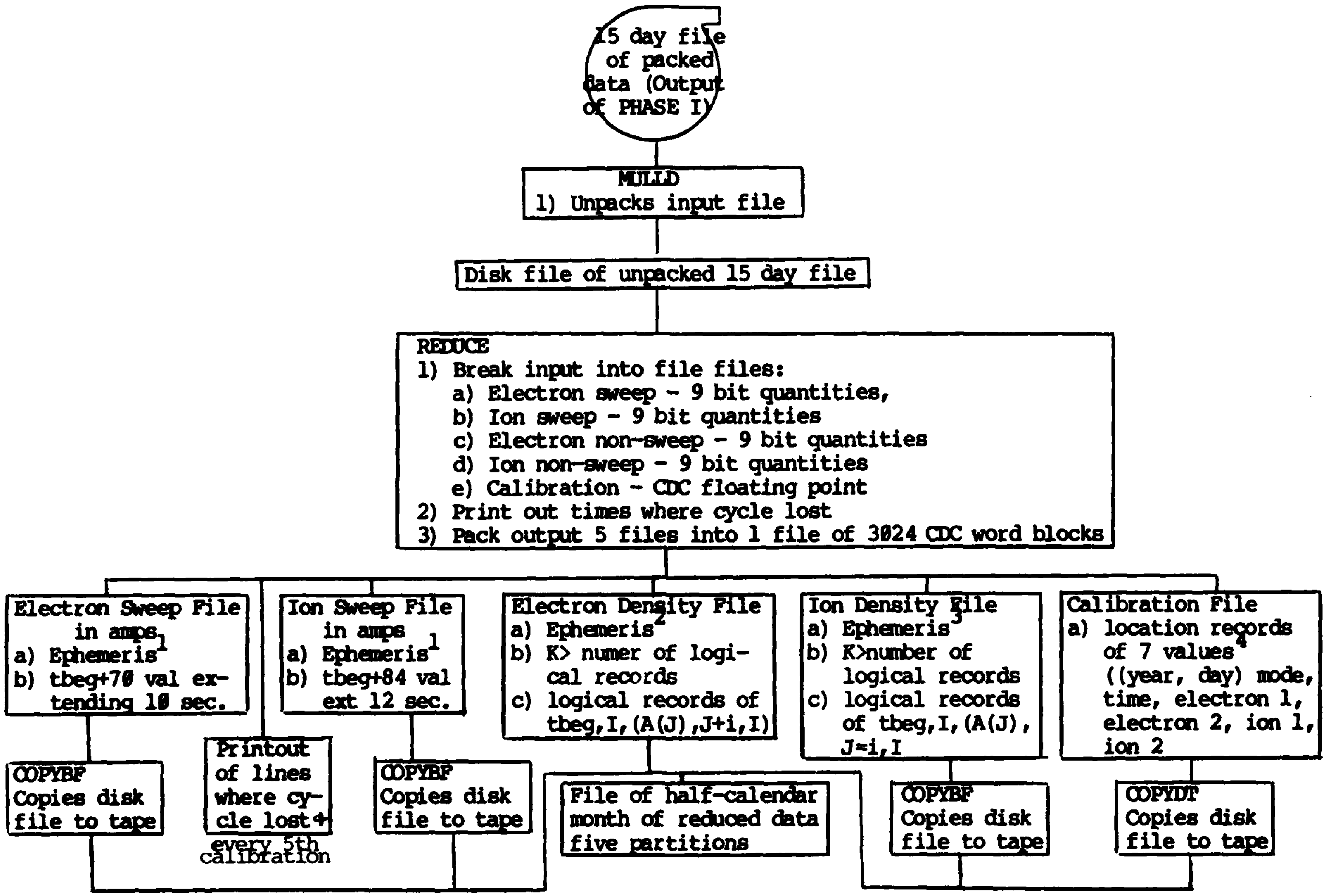


Figure 16

PHASE II



1. Closest ephemeris before beginning to sweep
2. Closest ephemeris before beginning of continuous non-sweep electron run should be at end of electron sweep.
3. Closest ephemeris before beginning of continuous non-sweep ion run should be at end of ion sweep.
4. Occurs every 1024 seconds.

Figure 17

3.1.1 Jobs Generated by IEDBC

All data is processed in units of half a calendar month (approximately 15 days). Either the first or second half of a calendar month is processed (e.g., 1-15 January or 16-31 January, etc.).

Five different options (batch jobs) can be created. They are as follows:

1) CONCAT - Merging of raw data tapes.

   Since the raw data tapes contain only one day of data, it is necessary to reduce the number of tapes for the production runs which process approximately 15 days of data. The SSIE data files from six raw data tapes are concantenated onto one output tape. Only the files labeled "IEPREPFILE" are copied.

2) PHASE 1 - The creation of a raw data base.

   One half a calendar month is processed. Output is put onto a scratch tape for further copying to a data base tape.

3) PHASE II - The creation of a reduced data base with "sweep" and "non sweep" separated.

   A half-month of Phase I output is processed. Output is put onto a scratch tape for further copying to a data base tape.

4) Copy the output of a Phase I or Phase II production run onto a data base tape.

   Six half-month outputs of Phase I or Phase II can be put onto one data base tape. The production runs do not put data directly onto a data base tape because too many problems occur, such as dead starts in the system or partial labels being put on the data base multi-file tape. Several jobs can be run simultaneously without affecting one another.

5) Create back-up tape for a given tape.

   Exact copy is made (including file names).

3.1.2. Operational Procedures of IEDBC

The following procedures should be done in the specified order to create the "IE" data base.

1) As soon as an integral multiple of six tapes are received from Offutt, they can be concantenated onto one output tape.

2) As soon as a complete half-month of data is on the output tapes of (1), Phase I can be run for this half-month. This output tape should be a temporary scratch tape.

3) Add the data of the output from (2) onto a data base tape. Six half-months of output from Phase I can be put onto one data base tape.

4) Run Phase II with the output of (3) which was recently added to the data base. This output should be put onto a temporary scratch tape.

5) Add the data of the output from (4) onto a data base tape. Six half-months of Phase II output can be put onto one data base tape (at 625Ø bpi).

6) If six Phase I or Phase II exist on a tape, then a back-up should be created by means of the tape copying option. After the tape is successfully copied, the "DMS" tapes can then be re-used for further processing.

7) The following relates to the interactive retrieval system.

   When procedures 3 or 5 (above) have run successfully, add a line to the file MULLENS/UN=SALVETT to indicate the addition of a new half-month to the data base. These lines should be added to the file in chronological order, i.e., April 83 data should follow March 83 and precede May 83.

3.1.3 How to Use the Interactive System (IEDBC)

Anyone with a valid password for the CYBER 170 computer at AFGL may utilize this interactive software system (IEDBC). The user merely logs into the computer which responds with

/

The user response is

GET,IEINTCR/UN=SALVETT (return)

System response is

/

User response is

IEINTCR (return)

The user is now prompted for such things as full or short prompting, name of job, accounting number of job, processing option desired, tapes needed, etc. All these prompts should be self-explanatory. Upon exit from IEDBC, the system responds with

/

The batch job created by IEDBC is now in file 'XX'. The user response should be

ROUTE,XX,DC=IN,TID=C

The batch job to do the particular processing option specified by the prompts is now on the input queue of the CDC computer and its output will be sent to Central.

3.2 DATA BASE RETRIEVAL

The purpose of IEDBR is to enable anyone who logs in via intercom to the CYBER 170 computer at AFGL to retrieve any part of the created data base of IE data. This system includes utility programs to enable the user to print out, graphically display, and further analyze the IE data.

If new applications are desired, the following must be done:

1) Write program to do new application and check it out with a batch job.

2) Add code to file "MAPLE/UN=SALVETT" to execute the program written in (1).

By studying how other application jobs are generated by "MAPLE", one can easily add new ones.

The system is completely interactive. That is, once access is gained, a running conversation can take place between the user and the system. At the termination of an interactive session, a batch job is created. This job reflects the processing desired by the user after answering various prompts.

3.2.1 How to Use the Interactive System (IEDBR)

Anyone with a valid password for the CYBER 170 computer at AFGL may utilize this interactive software system (IEDBR). The user merely logs into the computer which then responds with

/

The user response is

GET,IEINTAP/UN=SALVETT (return)

System response is

/

User response is

IEINTAP (return)

The user is now prompted for such things as

1. Full or short prompting
2. Do you want a listing of data base files and the tapes they are on?
3. Processing option desired
4. Etc.

.

.

.

All these prompts should be self-explanatory. Upon exit from IEDBR, the system reponds with

/

The batch job created by IEDBR is now on file "XX". The user response should be

ROUTE,XX,DC=IN,TID=C

The batch job to do the particular processing option (specified in the above interactive session) is now on the input queue of the CDC computer and its output will be sent to Central.

The following is a typical interactive session. The user desires a paper plot of a specified data interval.

```
GET,IEINTAP
/IEINTAP

     THIS IS THE SSIE INTERACTIVE PACKAGE
     FOR THE APPLICATION PROGRAMS
     IS THIS WHAT YOU WANT (Y/N)-
? Y

     DO YOU WANT FULL PROMPTING(Y/N)-
? Y

     DO YOU WANT TO SEE THE LIST OF AVAILABLE DATA
     (Y/N)-
? Y

     WHAT FOLLOWS IS A LIST OF THE AVAILABLE DATA.
     BY EXAMINING A LABEL, YOU CAN DETERMINE WHAT DATA
     IS ON THAT FILE.  A TYPICAL LABEL IS B2JAN83F6.
       THE B(E) MEANS THAT IT IS FROM THE BEGINNING(END)
       OF THE MONTH.  THE 2(1) MEANS THAT IT WAS GENERATED
       BY PHASE2(1).  ALL OPTIONS BUT LIST USE PHASE2.
     JAN IS THE MONTH, 83 IS THE YEAR, AND F6 IS THE
     SATELLITE.

      1)   CC1840   E1DEC82F6
      2)   CC1840   B1JAN83F6
      3)   CC1840   E1JAN83F6
      4)   CC1840   B1FEB83F6
      5)   CC1840   E1FEB83F6
      6)   CC1840   B1MAR83F6
      7)   CC1849   E2DEC82F6
      8)   CC1849   B2JAN83F6
      9)   CC1849   E2JAN83F6
     10)   CC1849   B2FEB83F6
     11)   CC1849   E2FEB83F6
     12)   CC1849   B2MAR83F6
     13)   CC0709   B1APR83F6
     14)   CC0709   E1APR83F6
     15)   CC0709   B1MAY83F6
     16)   CC0709   E1MAY83F6
     17)   CC0709   B1JUN83F6
     18)   CC0709   E1JUN83F6
     19)   CC0699   B2APR83F6
     20)   CC0699   E2APR83F6
     21)   CC0699   B2MAY83F6
     22)   CC0699   E2MAU83F6
     23)   CC0699   B2JUN83F6
     24)   CC0699   E2JUN83F6
      END OF LIST OF DATA
```

TYPE IN	TO USE APPLICATION
LIST	LIST THE TAPE DATA OUTPUT
DENS	GENERATE DENSITY PLOTS OF ION OR ELECTRON DATA
FILE	GENERATE A SYSTEM FILE OF TAPE DATA OUTPUT

```
    WHICH DO YOU WANT-
? DENS

    THE OPTION GENERATES JOB TO PRODUCE FLUX
    PLOTS FROM TAPE DATA.  IS THIS WHAT YOU
    WANT(Y/N)-
? Y

    WHAT DO YOU WANT THE FIRST 5 LETTERS OF
    THE JOB TO BE-
? MEEPL

    WHAT DO YOU WANT THE PROBLEM NUMBER TO BE-
? 5602

    WHAT DO YOU WANT THE PROJECT NUMBER TO BE-
? 7601

    WHAT IS YOUR LOGIN NAME-
? DMSP

    WHAT IS YOUR LOGIN PASSWORD-
? DMSP
        ***THIS OPTION ALLOWS FOR A MULTIPLE NUMBER
        OF TAPES TO BE PROCESSED.  PLEASE GROUP ALL
        REQUESTS TO A PARTICULAR TAPE TOGETHER.  THIS
        WAY, IT WILL NOT RELOAD TAPES.

    WHAT TAPE IS THE DATA ON-
? CC0699

    DO YOU KNOW THE TAPE LABEL OF THE DATA YOU
    WANT(Y/N)-
? Y

    WHAT IS THE TAPE LABEL-
? B2JUN83F6
```

```
    PLEASE INPUT THE FIRST 3 LETTERS OF YOUR LAST NAME,
    A SPACE, THEN YOUR EXTENSION -

? MEE 3622


    WE WILL PLOT EVERY NTH POINT.  TYPE N(Ø1...99)-
? Ø1

    DO YOU WANT THE PLOTS TO GO ON PAPER OR
    MICROFICHE(PAPER,MICRO)-
? PAPER

    DO YOU WANT TO ENTER INTERVALS BY WHOLE DAYS
    (Y/N)-
? N

    NOW ENTER THE START TIME OF THE INTERVAL YOU
    WANT IN THE FOLLOWING FORMAT
       DAY OF MONTH, BEG SECONDS, END SECONDS
       I.E. 11,378ØØ,45ØØØ IS 1Ø:3Ø TO 12:3Ø ON FEB 11

    ENTER TIME   1 (MDAY,BEG SEC, END SEC)-
? 1Ø,3ØØØ,5ØØØ

    IS THERE ANOTHER TIME INTERVAL YOU WANT(Y/N)-
? N

    DO YOU WANT ANOTHER TAPE(Y/N)-
? N

    DO YOU WANT ION, ELECTRON OR BOTH DENSITY PLOTS
    (ION,ELE,BOT)-
? ION
```

```
HERE IS A SUMMARY OF THE JOB TO BE PRODUCED

     10)  MEEPL IS THE JOB NAME
     20)  5602 IS THE PROBLEM NUMBER
     23)  7601 IS THE PROJECT NUMBER
     30)  DMSP   IS YOUR LOGIN NAME
     33)  DMSP   IS YOUR LOGIN PASSWORD
     40)  THE PLOTTING BANNER WILL BE
               MEE 3622
     45)  WE WILL PLOT EVERY  1  POINTS
     50)  THE PLOTS WILL GO ON PAPER
     60)  THE PLOTS WILL BE ION DENSITY PLOTS

     TIME INTERVAL EDITING OPTIONS--
     70)  RE-ENTER ALL DATA SECTIONS
     80)  ADD MORE SECTIONS TO THE END
     90)  DELETE THE LAST SECTION(THE LAST TAPE
          LABEL AND ITS TIME INTERVALS)

TAPE=CC0699            LABEL=B2JUN83F6
10      3000             5000

ENTER THE LINE NUMBER ON WHICH AN ERROR OCCURS.
A NEGATIVE NUMBER SUPPRESSES THE NEXT SUMMARY.
I.E., 10 OR -10 TO ALTER THE JOB NAME.
A "0" CAUSES A JOB TO BE CREATED WITH THE ABOVE PARAMETERS.

? 0


A JOB WILL BE CREATED ON FILE XX.
PLEASE WAIT FOR THE PROMPT "/" TO APPEAR,
THEN TYPE IN-
     ROUTE,XX,DC=IN
$REVERT.CCL
/
```

4. DESCRIPTION OF SYSTEM MODULES

In this chapter are verbal descriptions of each of the major programs and routines of this software system. Refer to Figure 18 for a breakdown of system files. The following modules described are in the library files MINTERACT and MLIBCODE (also described in Figures 16 and 17) for the subsystem IEDBC, and in files MAPLE and MAPPCODE for subsystem IEDBR. MINTERACT and MAPLE are the interactive programs which set up the batch jobs. These batch jobs utilize the programs in the libraries called MLIBCODE and MAPPCODE.

Following the description of each library are charts showing the structure of each program in the file.

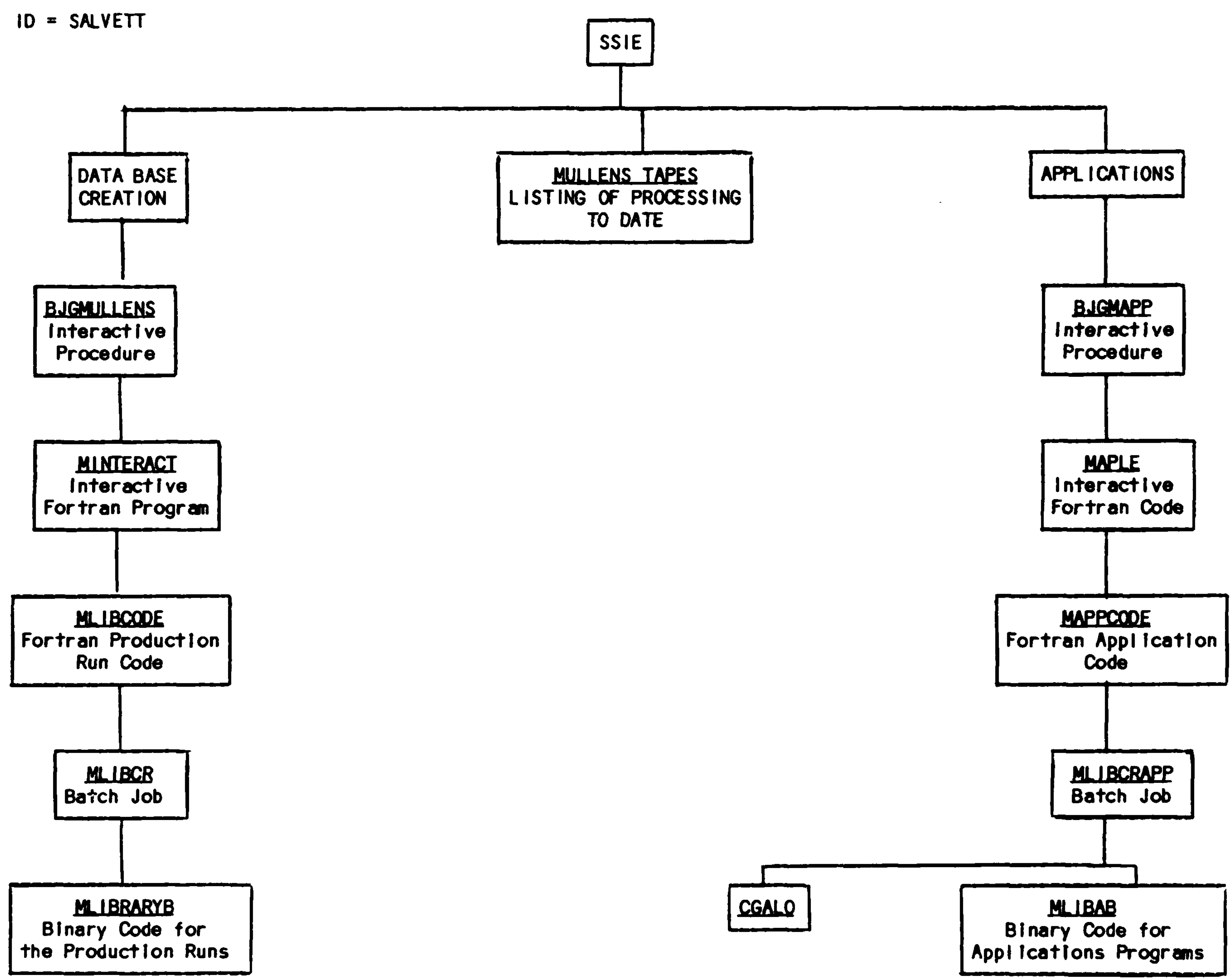

ID = SALVETT
SSIE
DATA BASE CREATION
MULLENS TAPES
LISTING OF PROCESSING TO DATE
APPLICATIONS
BJGMULLENS
Interactive Procedure
BJGMAPP
Interactive Procedure
MINTERACT
Interactive Fortran Program
MAPLE
Interactive Fortran Code
MLIBCODE
Fortran Production Run Code
MAPPCODE
Fortran Application Code
MLIBCR
Batch Job
MLIBCRAPP
Batch Job
MLIBRARYB
Binary Code for the Production Runs
CGALO
MLIBAB
Binary Code for Applications Programs

Figure 18

4.1 FILE MINTERACT - (Interactive Program for IEDBC)

INTR - A main program that introduces the interactive package for IEDBC. It prompts for the particular application desired.

STEP1 - A subroutine that sets up the job for Phase I, prompting for tape names, file names, satellite, etc.

STEP2 - A subroutine that sets up the job for Phase II, prompting for tape names, file names, satellite, etc.

COPY - A subroutine that sets up a job to copy a half-month output file from Phase I or Phase II to the IE database.

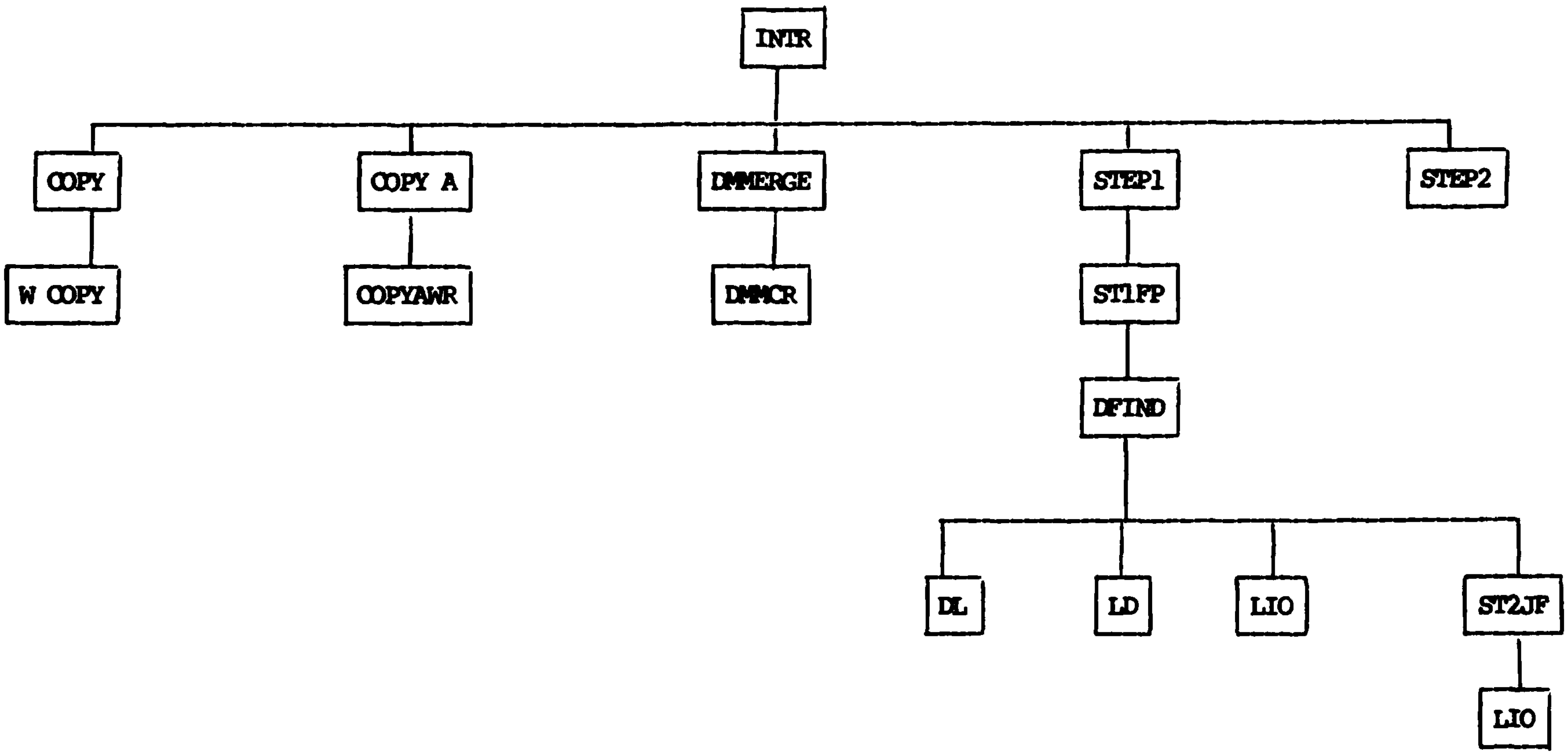
WCOPY - A subroutine that generates the CYBER language statements from prompts specified in the routine "COPY".

ST1FP - Called by subroutine STEP1 to prompt the user further and generate some CYBER statements for Phase I.

ST2SF - Called by subroutine STEP2 to prompt the user further and generate some CYBER statements for Phase II.

DMMERGE - A subroutine that sets up the "CONCAT" job, prompting the user for the input "DM" tapes, the output tape, satellite, etc.

COPYA - A subroutine that creates a job to generate a backup of the database tape; it copies the file names as well.



TREE GRAPH OF INTERACTIVE PROGRAM FOR IEDBC

Figure 19

4.2 FILE MLIBCODE - (Routines of IEDBC)

FEDIT - Eliminates incorrect input data frames and does correction for some erroneous times. A Phase I program.

EDIT - A subroutine called by FEDIT; does the time editing.

REDUCE - A program that breaks up the input data into five files (ion sweep, ion non-sweep, electron sweep, electron non-sweep, calibration) according to monitor values. Refer to Figures 8 and 20 for an explanation of monitor values.

WHICH - A subroutine called by REDUCE; decides what type of data is presently processing by looking at the monitor values.

MOVE - A subroutine called by REDUCE; preserves a 3-minute window as program moves through file.

OUT - A subroutine called by REDUCE; outputs the sweep and calibration data and prepares the density values for outputting.

CALIB - A subroutine called by OUT; calculates the in-flight intercept A and slope B from the calibration.

OUTCH - Called by REDUCE; separates ION and ELECTRON density values into two files.

PACKCH - Called by OUTCH; packs N channel counts in array CH into array IP, returning the number (IW) of words of IP which hold the packed channel data.

COMMENTS

Monitor values indicate change in mode of input data, e.g., is it calibration data, sweep or non-sweep data. Following is a list of the various modes of data.

The nine bit quantity for each channel count indicates a voltage divided by 1ØØ, e.g., the values go from Ø. $\longrightarrow$ 5.11.

Four quantities are calculated depending on sweep or non-sweep mode.

ED = Electron current $\longrightarrow$ sweep = C1[1] + C2*EDT[2]*.Ø1

ED = Electron density $\longrightarrow$ non-sweep - 1Ø.**(EC+C3)

IC - Ion current $\longrightarrow$ sweep = C4*EDl[3]*.Ø1

ID = Ion density $\longrightarrow$ non-sweep = 1Ø.**(IC+C6)

1. C1,C2,C3,C4,C5,C6 are constants given to us by initiator for each flight.
2. Actual electron 9-bit quantity from tape.
3. Actual ion 9-bit quantity from tape.

Figure 2Ø

PACKE - Called by OUTCH; packs the ephemeris into array IPD starting at IPD (N+1), incrementing N for each word used.

OT2 - Called by OUT; packs electron sweep ephemeris and data onto TAPE2.

OT1 - Called by OUT; packs ION sweep ephemeris and data onto TAPE1.

MAGTIM - Calculates geomagnetic local time.

COPYDT - A program that copies the calibration data from disk to tape.

DUMP - First program of Phase I; gets the DMSP data off the merged raw data tapes, doing some editing and data elimination. When necessary, it also splits the data into a data frame file and an ephemeris file.

INFO - Called by DUMP; contains all the code related to processing information blocks.

BOUT - Called by DUMP; outputs the data frames to TAPE5 and the ephemeris to TAPE8.

IREAD - Called by DUMP; finds the beginning of data set and sees if the next record is needed; checks for readouts embedded in data.

IN - Called by IRED; buffers in and unpacks a block of data.

PRINFO - Called by INFO; prints out variables of the information block.

CHECK - Called by INFO; decides whether or not to reject a readout and prints a summary of saved and rejected readouts.

CONV - Converts a packed 1108 36-BIT real number to CDC 60-BIT real number.

STEP - Preserves a 2-minute window while moving through data.

INTER - Generates interpolated values of ephemeris.

REAL - Interpolates input data to specified coordinate.

MERGE - Last program of Phase I; merges the ephemeris with the data frame data and packs it into large blocks for the output.

MFILL - Called by MERGE; reads in data for packing.

MIOUT - Called by MERGE; packs data into array IOUT3 for outputting.

COPY4 - A program that copies the tape file produced by REDUCE to another tape.

IEF - A program that finds file IEPREPFILE leaving the tape read/write head at the first block of the "DM" tape.

FLCOPY - Used in copying multi-file tapes. It creates a procedure to copy each label file by looking at a "LISTMF" output with the EOF's removed.

GETFL - A program used in "CONCAT" job to find the "IEPREPFILE" on tape 1 and copy it to tape 7.

UNIVCH - A routine called by GETFL. It translates Univac characters to CDC characters.

TREE GRAPH OF PROGRAM "DUMP" OF PHASE I

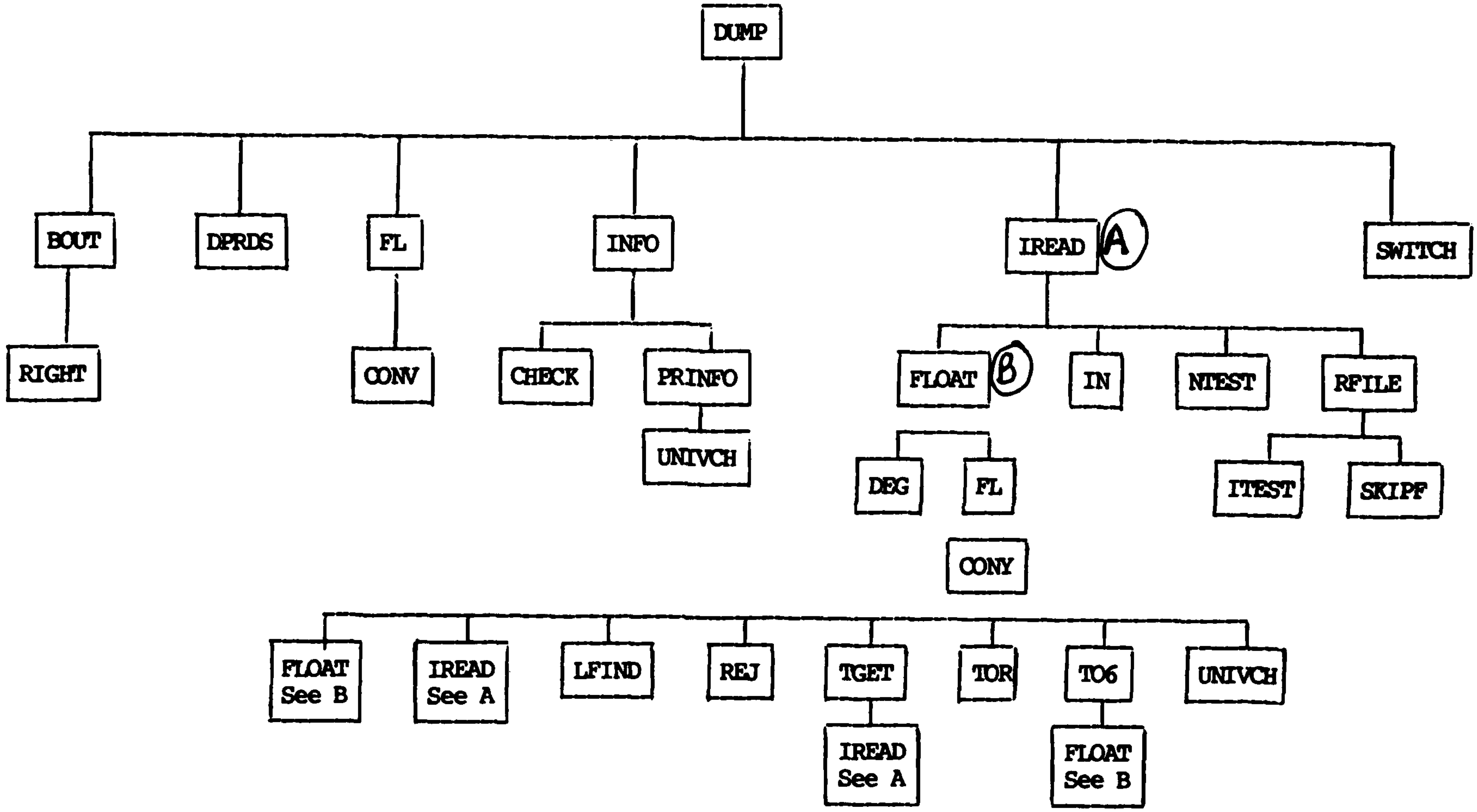
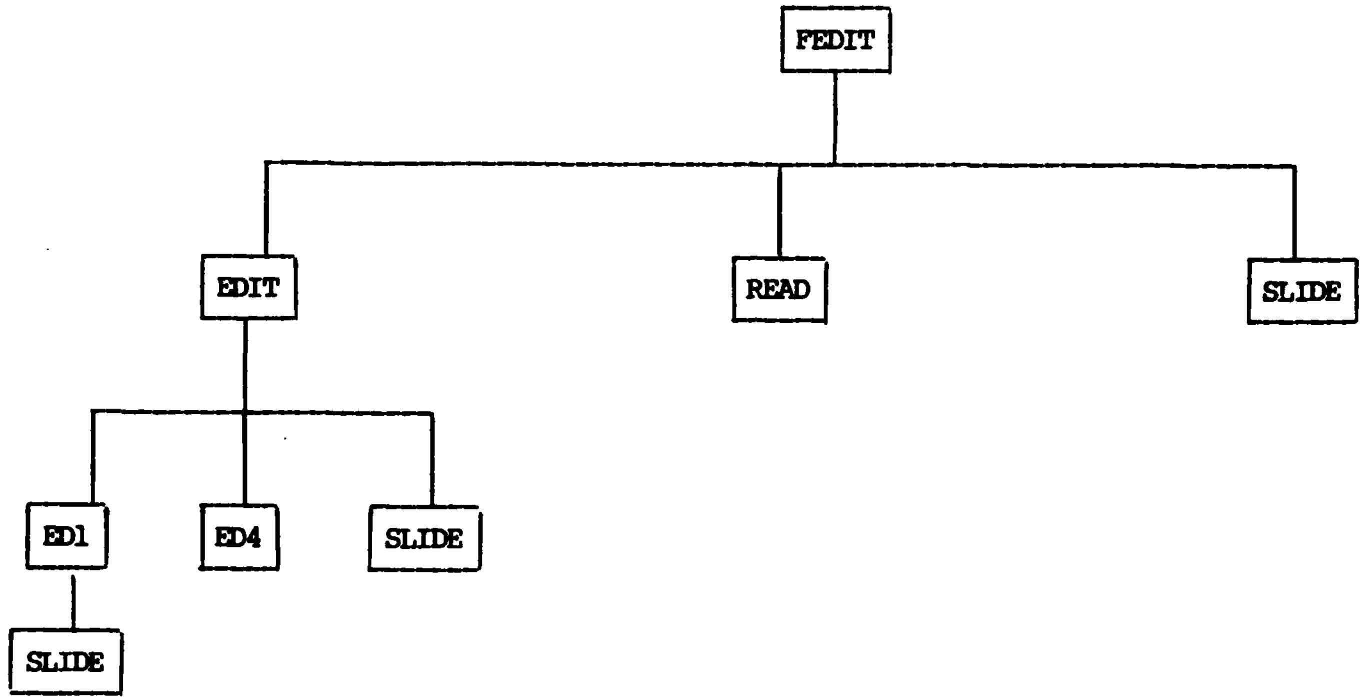
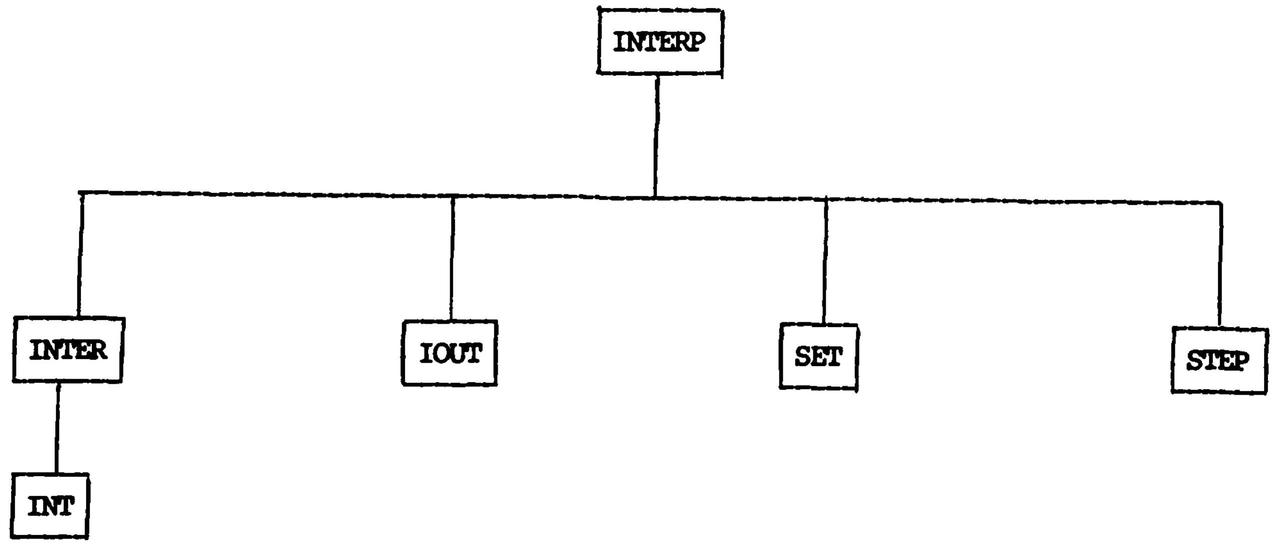


Figure 21



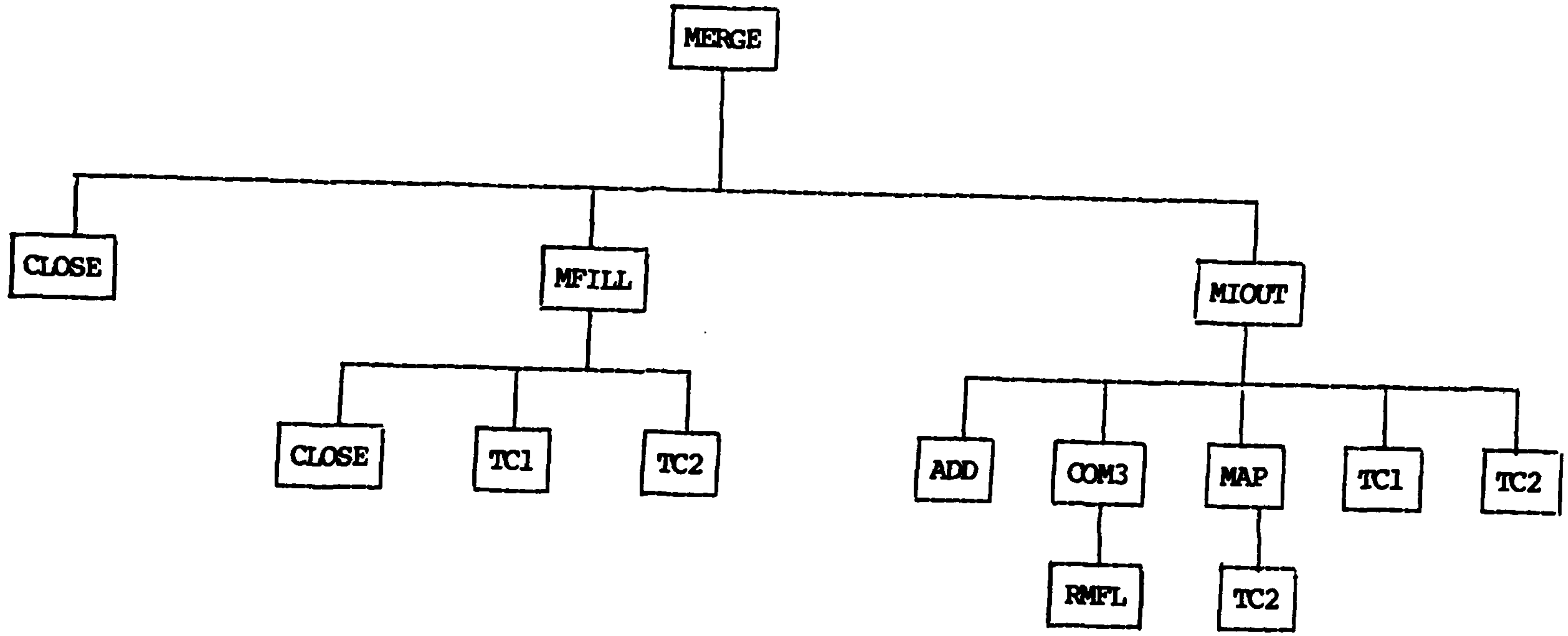
TREE GRAPH OF PROGRAM "FEDIT" OF PHASE I

Figure 22



TREE GRAPH OF PROGRAM "INTERP" OF PHASE I

Figure 23



TREE GRAPH OF PROGRAM "MERGE" OF PHASE I

Figure 24

TREE GRAPH OF INTERACTIVE PROGRAM FOR IEDBR

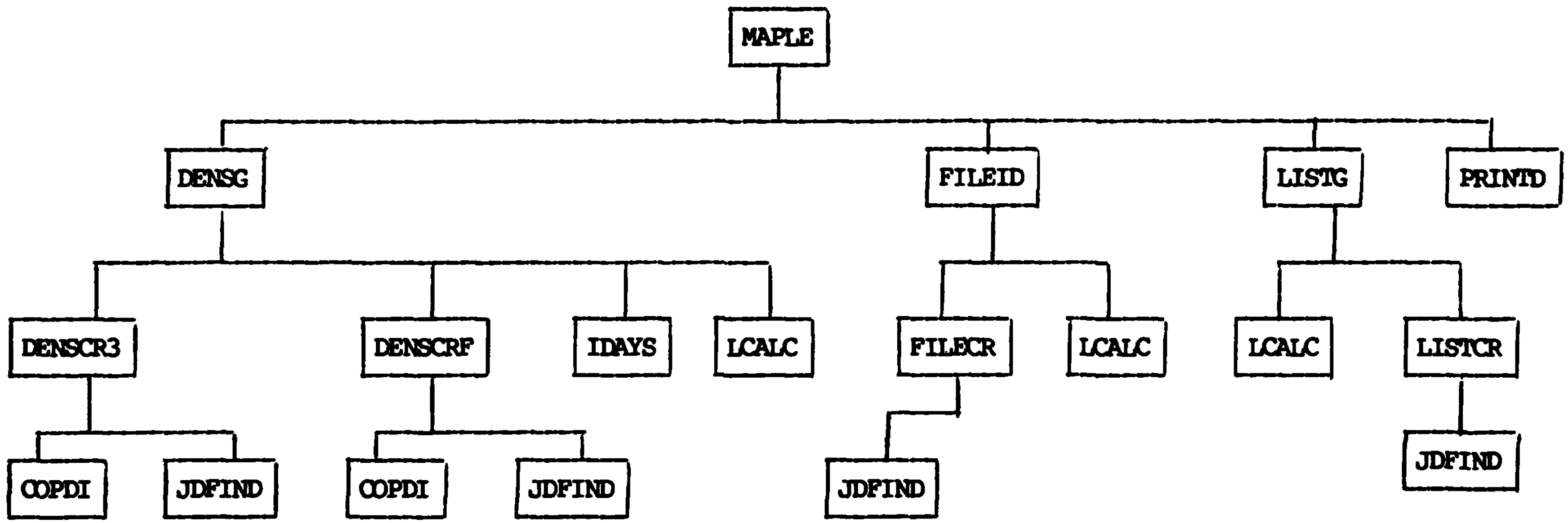


Figure 25

4.3 FILE MAPLE

MAPLE - The main program which introduces the interactive package for IEDBR. It prompts for the particular application desired.

LCALC - A subroutine that generates the desired tape label after prompting the user for information.

DENSG - A subroutine that generates a job to make density plots. First collects the data through user prompts (giving the user a chance to edit the data), then generates the Cyber statements.

DENSCR3 - A subroutine called by DENSG. Actually generates the Cyber statements and input data to plot ION data.

JDFIND - A subroutine that calculates the Julian Day of a month, given the month and the year.

IDAYS - A subroutine that prepares day strings to be input by programs.

LISTG - A subroutine that generates a job to unpack the database data and list it.

LISTCR - A subroutine called by "LISTG"; actually generates the Cyber statements and input data to unpack and list the database.

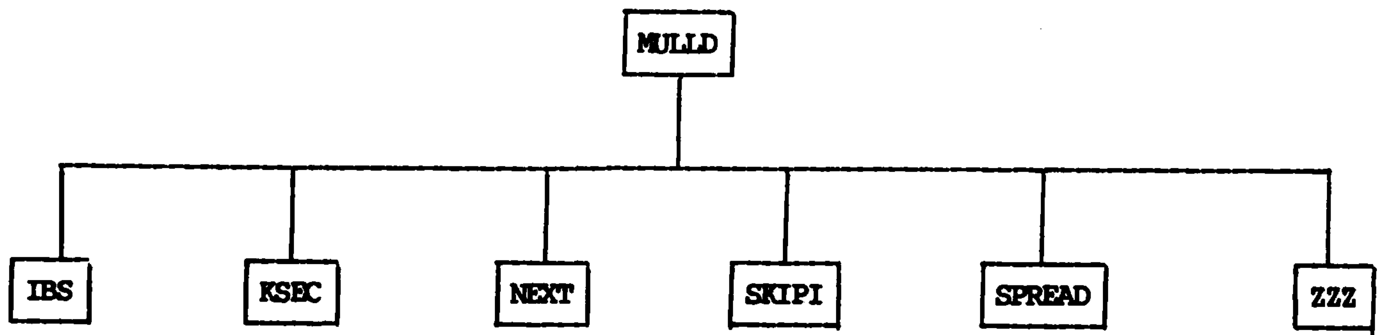
DENSCR4 - A subroutine called by DENSG; actually generates the Cyber statements and input data to plot ELECTRON data.

FILEID - A subroutine that creates a job to generate a data file from the database.

FILECR - A subroutine called by "FILEID"; actually generates the Cyber and data statements for file creation.

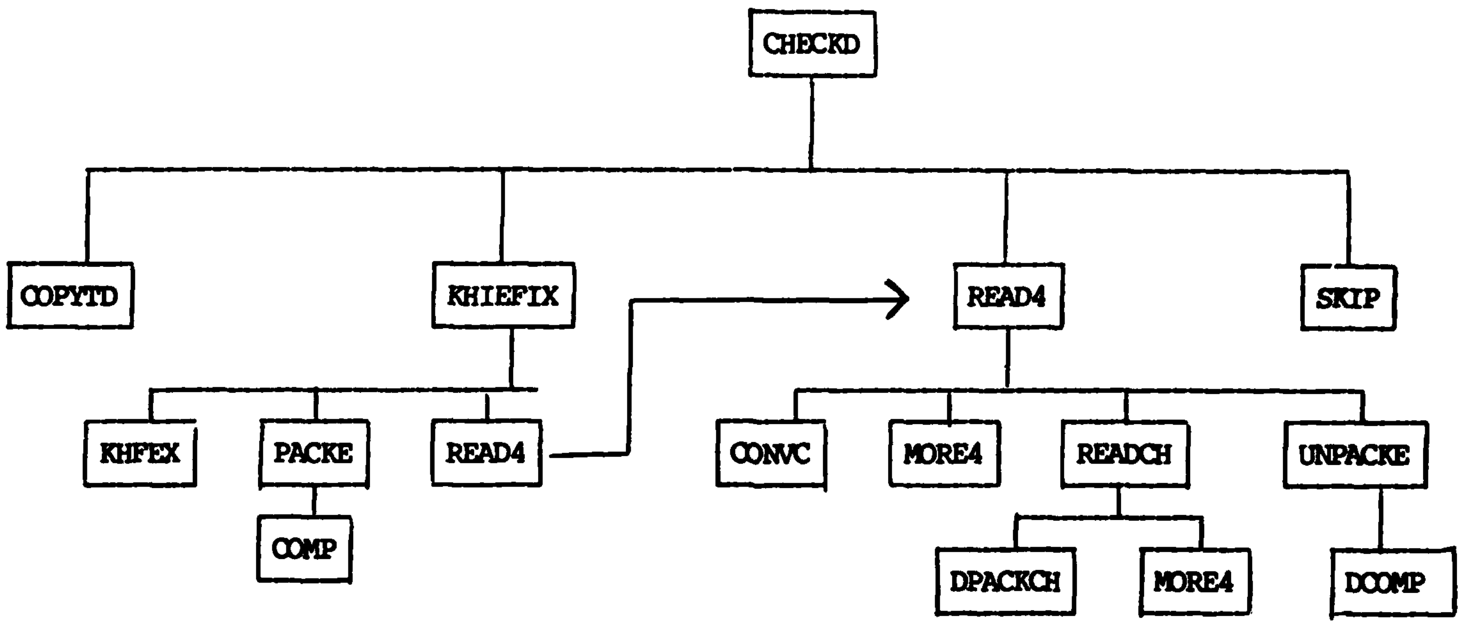
4.4 FILE MAPCODE (Routines of IEDBR)

MULL	-	Unpacks the data packed by Phase I used in Phase II and the application programs.
CHEKD	-	Lists ION or ELECTRON density data in one of three forms: bit values, counts or calibrated counts.
READ4	-	Called by CHEKD to unpack ephemeris values.
CONVC	-	Called by READ4; converts volts to current values.
COYTD	-	Called from CHEKD; inputs and unpacks the calibration file.
SKIP	-	Skips to the desired day on the input database tape.
MPLOT	-	A main program; generates the density plots for the ION or ELECTRON data.
BAYIS	-	Called by MPLOT; draws the 4-axis block for the density plots.
DRAW	-	Called by MPLOT; draws the density curves.
ANNOTATE	-	Called by DRAW; writes some ephemeris values at bottom of graph.
INTR	-	Linearly interpolates on two input points.



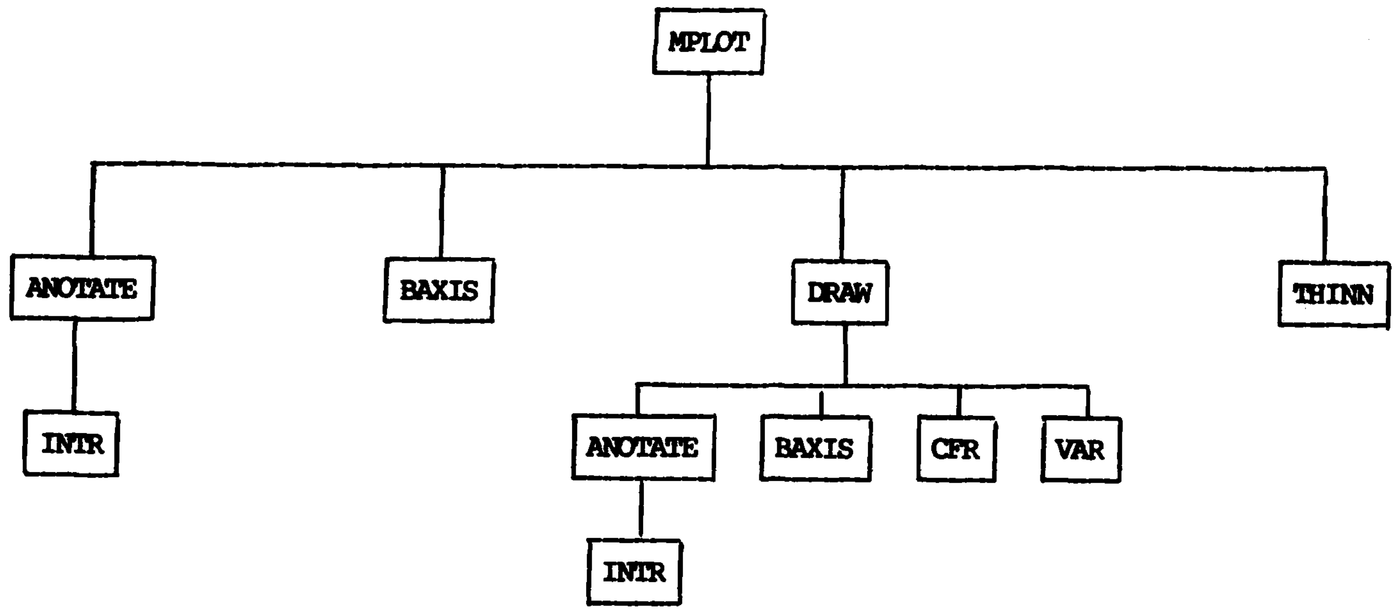
TREE GRAPH OF PROGRAM "MULLD" OF PHASE II

Figure 26



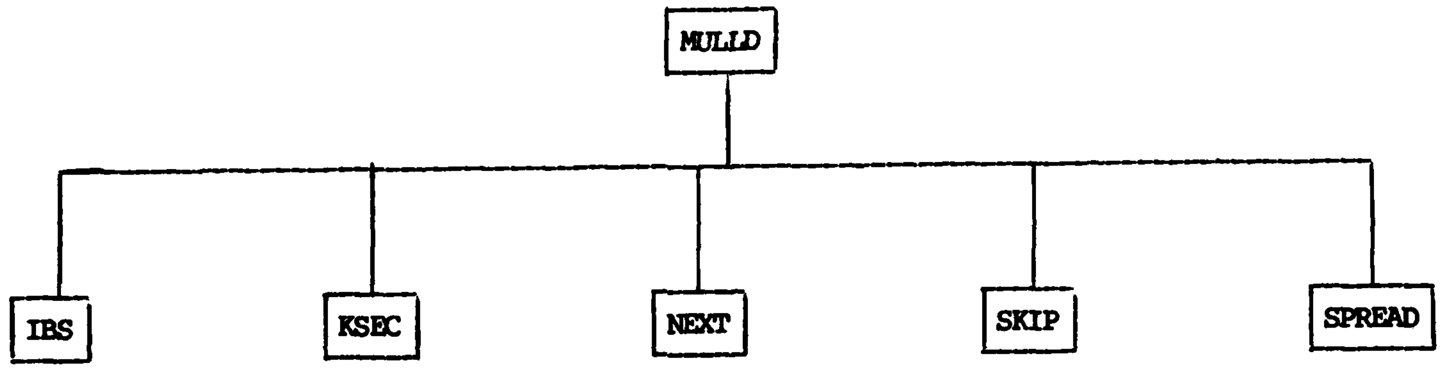
TREE GRAPH OF PROGRAM "CHECKD" OF IEDBR

Figure 27



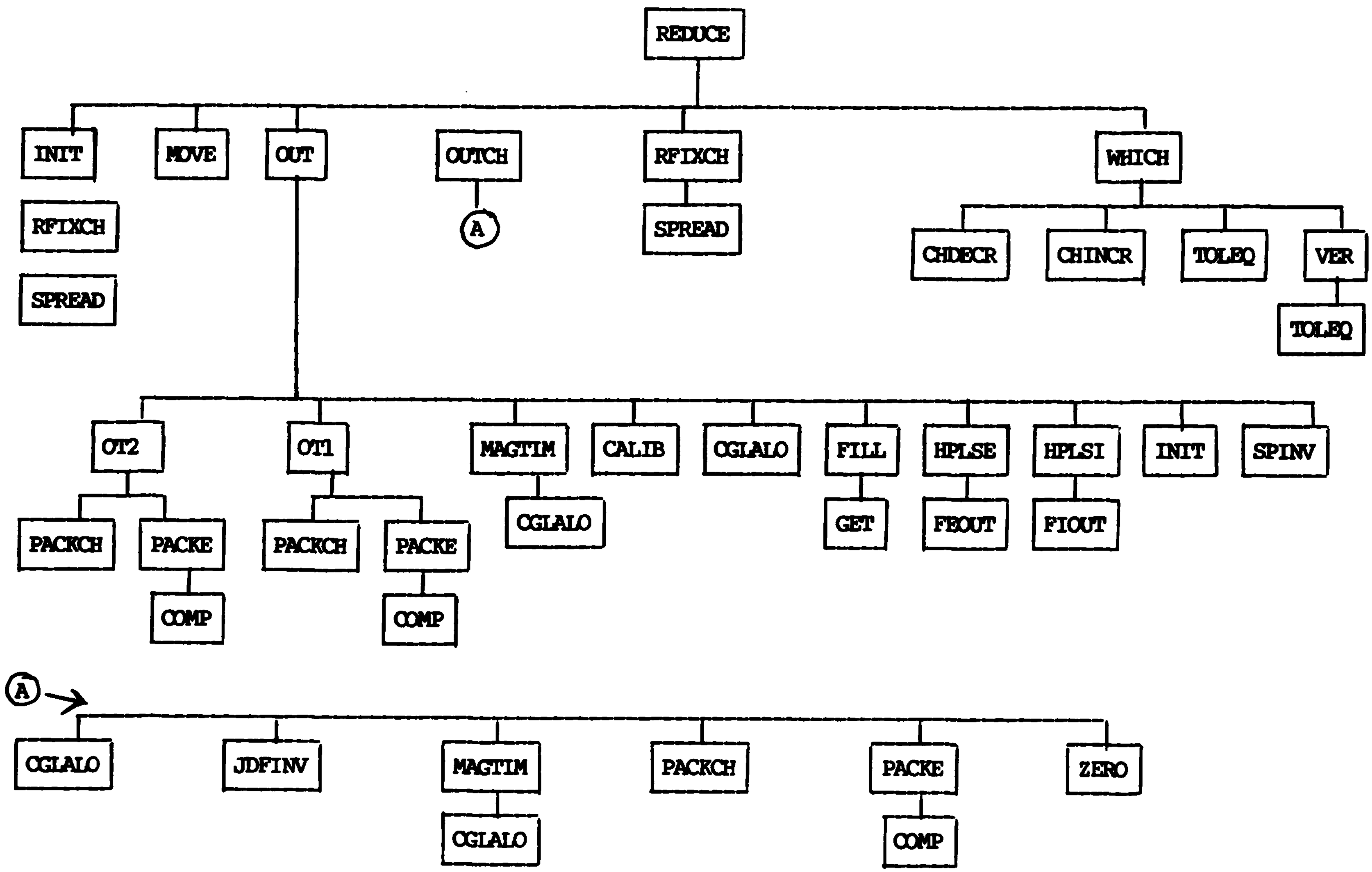
TREE GRAPH OF PROGRAM "MPLOT" OF IEDBR

Figure 28



TREE GRAPH OF PROGRAM "MULLD" OF IEDBR

Figure 29



TREE GRAPH OF PROGRAM "REDUCE" OF PHASE II
Figure 30

REFERENCES

1. Rich, F. et al. "In-flight Characteristics of the Topside Ionospheric Monitor (SSIE) on the DMSP Satellite Flight 2 and Flight 4", Air Force Geophysics Laboratory, Hanscom AFB, MA, 17 April 1980, AFGL-TR-80-0152, ADA088879.

2. Smiddy, M. et al. "The Topside Ionosphere Plasma Monitor (SSIE) for the Block 5D/Flight 2 DMSP Satellite", Air Force Geophysics Laboratory, Hanscom AFB, MA, 22 March 1978, AFGL-TR-78-0071, ADA058503.